

# **THE MECHANICS OF** **BREATHING**

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Breathing consists of two movements:

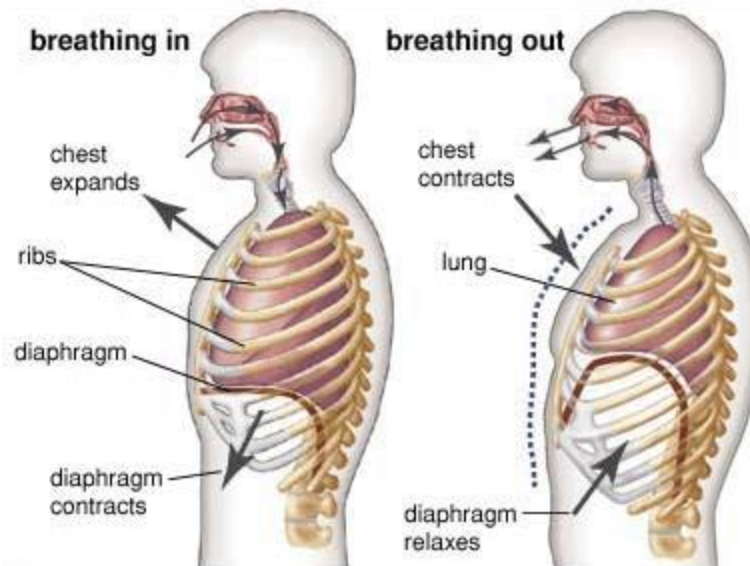
INHALATION (inspiration – AIR IN)

EXHALATION (expiration – AIR OUT)

Action	Diaphragm	Intercostal Muscles (IM)	Lungs		Air movement
			volume	pressure	
Inhale	contracts (flattens)	External IM contract (pull ribs up and out)	↑	↓ ↓	Air in
Exhale	relaxes (rises)	External IM relaxes (ribs down)	↓	↑	Air out

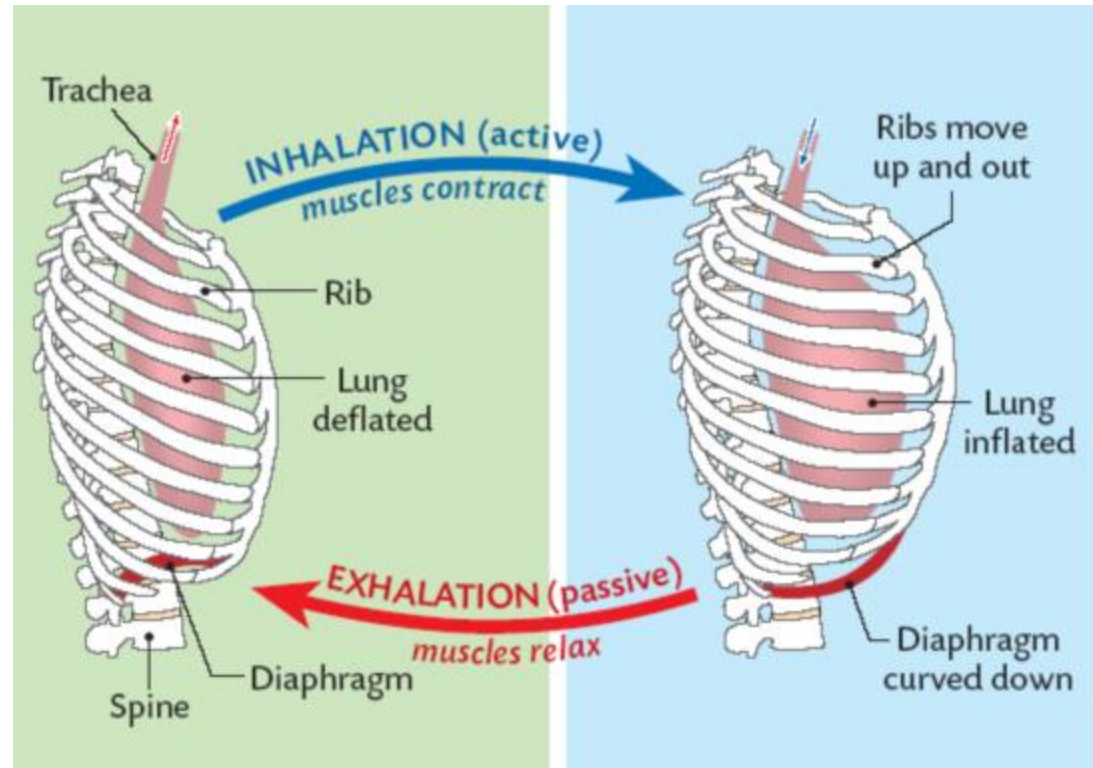
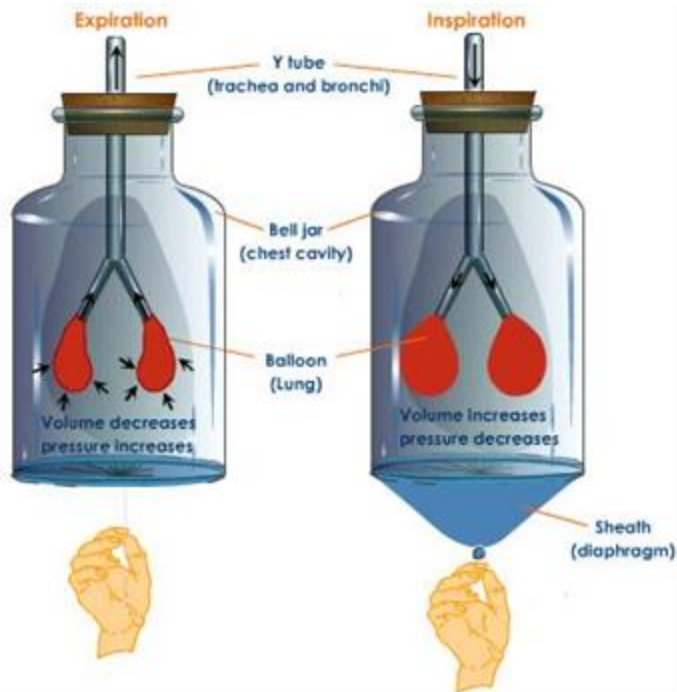
**Based on negative pressure (Boyle's Law)**

# See diagram on page 288.



During strenuous exercise, **internal intercostal muscles** will contract to pull the ribcage down to force air out of lungs more quickly.

# Mechanisms of Ventilation (Breathing/external respiration)



# **LUNG CAPACITY**

**– the amount of air that can be drawn into the lungs.**

## **FACTORS AFFECTING LUNG CAPACITY:**

1. Illness (allergies, emphysema, asthma, pneumonia, cold etc).
  - cause constriction of the tubes in the lungs, damage to lung tissues, accumulation of fluid in the lungs or mechanical difficulties in breathing.
2. Sex/Body size –lung size is directly proportional to the size of the person.
3. Pollutants/smoking – pollutants cause structural damage to the walls of the lungs as they accumulate over the years.

4. Age – L.C. tends to decrease with age after becoming an adult due to wear-and-tear.
5. Fitness level – Regular exercise increases the muscular ability of the chest cavity resulting in more efficient use of the lungs.
6. Biggest effect would be on how efficiently you transport and use the oxygen once it is inside (usage of oxygen).

# Oxygen Usage

- the rate oxygen is used by the body is measured as the **VO<sub>2</sub>**, is measured as mL O<sub>2</sub> / kg body mass / min. (mL/kg/min).
- **VO<sub>2</sub>max** is the maximum oxygen that an individual can consume, it reflects the physical fitness on an individual.
- athletes often have their **VO<sub>2</sub>max** measured to monitor their fitness levels.

# Interesting.....

- The amount of oxygen in the air that you breathe in is approximately **20.95%** by volume (the other major components of air are nitrogen, argon, and carbon dioxide at 78.08%, 0.93%, and 0.03% by volume respectively).
- If you consumed all of the oxygen that you breathed in you would expect to find that the amount of oxygen in the air that you breathed out would be 0%, but it is typically in the **15% to 18% range**, depending on what you are doing and a number of other factors

# Measuring Lung Capacity

- The amount of air moved by a normal individual breathing, while at rest, is called the **tidal volume**.
- At the end of a normal expiration, if you can forcibly **push out** as much air as you can, the air you remove is called the **expiratory reserve volume**.
- The amount of extra air you can forcefully **pull in** at the end of a normal inhalation is called the **inspiratory reserve volume**.

**Vital capacity = tidal volume + expiratory reserve + inspiratory reserve**

(**Vital capacity** is the maximum amount of air a person can expel from the lungs after a maximum inhalation)

No matter how hard you try to push out the air of the lungs, there will always be a small amount left in the spaces and tubes. This is called the **residual volume**. (1000 cm<sup>3</sup>)

For an average adult, **typical** capacities are:

***Expiratory Reserve Volume ..... 1 500 cm<sup>3</sup>***

***Tidal Volume ..... 500 cm<sup>3</sup>***

***Inspiratory Reserve Volume.....2 000 cm<sup>3</sup>***

***Vital Capacity***

***4 000 cm<sup>3</sup>***

\* lung capacities are measured using a spirometer.



Men : up to 4 800 cm<sup>3</sup>

Women : up to 3 800 cm<sup>3</sup>